International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 10, October 2014)

Sesbania Aculeata: A Plant for Colouring Cotton and Silk Fabric

Sangita Saini[1], Preeti Satsangi[2]
Dayal Bagh Educational Institute, (Deemed University) Dayal Bagh Agra-282005, India

Abstract **--Plants have been a source of dye since historical times. Use of natural dyes has increased several folds in the past few years due to the eco-friendly approach. This paper concerns with the extraction of natural dye from an abundantly occurring plant 'Sesbania aculeate'. Aqueous extraction method was used for the extraction of the dye. The dye powder was used for dyeing of scoured cotton and silk fabrics using five bio-mordants myrobalan, gooseberry, tea-leaves, pomegranate and sweet lemon in 1:10 ratios. Dyeing with mordanting included pre, post and simultaneous mordanting techniques. Various shades were obtained on cotton and silk using the dye extract. This study proposes the use of sesbania aculeate as a dye for coloring cotton and silk fabrics.**

Key Terms**--Bio mordants, Colorfastness, Sesbania aculeata, cotton and silk.**

I. INTRODUCTION

Dyeing is an old art of human civilization. From the historical records it is learnt that plants being the prime source of natural colorants were being used by people during Greek-Roman periods. Our Vedas especially the Atharveda carry description of natural dyes. The use of natural dyeing materials is quite evident in the wall paintings of Ajanta, Ellora and Sithannvasal. These masterpieces still demonstrate the efficacy of dyeing craft that had been inherited from ancient times in India.

Natural dyes and colorants are an essential part of the world's ecological and cultural heritage. The use of plants, seashells and coccid insects to create color which is common to all civilizations (Adeel et al., 2009). According to Chengalah B. et.al. [2010], the worldwide demand for natural dyes is now a day of great interest due to the increased awareness on therapeutic properties of natural dyes in public. Natural dyes are less toxic, less polluting, less health hazardous, non- carcinogenic and non-poisonous. The harmonizing colours of natural dyes are gentle, soft, and create a restful effect. Besides this they are environment-friendly and can be recycled after use.

The revival of natural dyes has begun due to the hazardous and carcinogenic nature of synthetic dyes and an eco-friendly drive around the globe.

In India there is a large base of plant resource and very little has been exploited so far. Green manure plant, *'Sesbania aculeata',* commonly known as *Dhaincha* was chosen for the study. The dye extracted from this would not result in any wastage of an otherwise highly commercial or edible product. This plant has low maintenance and operation cost and a high yield. Sesbania is a genus of flowering plants known as Fabaceae or Leguminosae which is third largest family of flowering plants, also known as the legume family.

II. EXPERIMENTAL

Sesbania aculeata plants were grown and their growth pattern was studied. Fully grown plant of 12 to 14 week were collected. Bleached and scoured cotton, bleached and scoured silk were used for dyeing purpose. Laboratory grade solvents, reagents and mordants such as myrobalan, gooseberry, tea-leaves, pomegranate and sweet lemon were used as bio mordants. Initially 2 methods were used for dye extraction from the plant by aqueous and solvent extraction methods. Out of these aqueous extractions method was more efficient and less time consuming. Hence it was adopted for the study. Open dyeing bath was used to carry out all dyeing.

III. METHOD

Growth Pattern Of Sesbania Aculeata

Seeds of Sesbania aculeate were introduced at depth of 2 inches. Germination time was about a week. After germination weekly growth rate was measured. This was followed till flowering stage (Figure I). After full growth, leaves were separate from the plant to measure total yield per plant. Leaves were dried in shade for more than 30-40 days. The leaves were crushed into powder form for dyeing. Weight records were maintained to calculate yield of crop.

International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 10, October 2014)

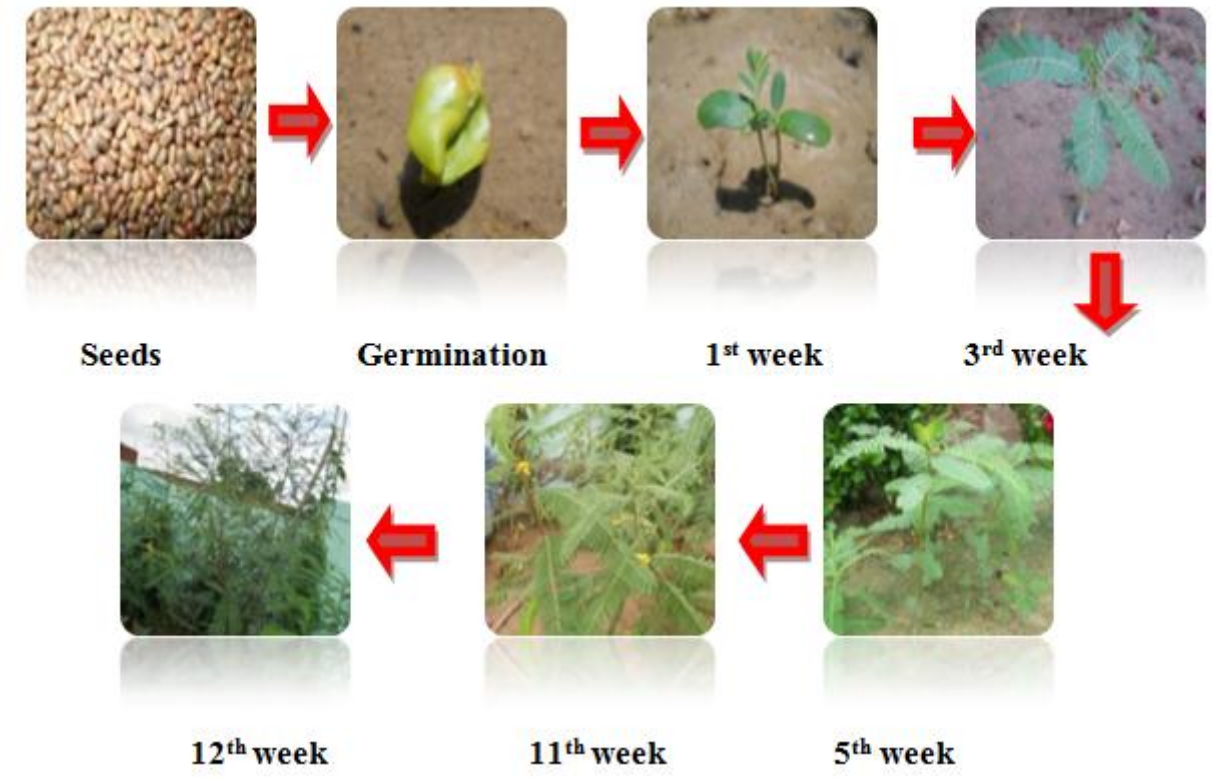


Figure I: Growth Pattern Of Sesbania Aculeata Plant

IV. DYEING

The leaves were removed and dried in shade. The dried material was finely grounded to form a fine powder. For extracting the dye, aqueous extraction method was carried for 3 hrs and temperature was maintained around 60-65 degree Centigrade. The color of the extract was rusty green (Figure-II)

Figure II: Rusty Green Coloured Extract Of Sesbania Aculeate Plant

Before dyeing fabric was pretreated (cotton**:** 5 gm\1 lit 90◦c for 60min and silk 5gm\1lit. at 55◦c for 30 min) Swami C. et al (2012). Fabrics were mordanted by the five mordants.

Three different processes of mordanting in concentration of 10% were pre mordanting, simultaneous and post mordanting methods. Dyeing of the mordanted samples was carried out in a dye bath at a temperature of 65°C for three hours. The material: liquor ratio was 1: 30. After the dyeing was complete, dyed samples were dipped in a common salt solution at room temperature for 1hour for fixing of the dye. The dyed material was dried and then washed thoroughly in cold water to get rid of extra dye.

V. RESULT AND DISCUSSION

Total Yield Per Plant

- ✓ Total yield per plant represents the overall productivity of the plant. The study indicated the total yield representing the weight of average leaves acquired per plant of Sesbania aculeata.
- ✓ The seeds were sown at 2 inches depth.
- ✓ The plants were sown at 6 inches distance.
- ✓ The plants need watering before germination. Therefore it needs watering once in a month.
- ✓ After 12 to 14 weeks from sowing, the plants are fully grown.

International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 10, October 2014)

- ✓ The plants varied in length and hence were categorized in three groups on the basis of height.
- ✓ The leaves of each group were separated. (Table I) gives the average weight of wet leaves, dry leaves and the powder form of the three groups of Sesbania aculeata.
- ✓ It took about 4 to 5 weeks for the leaves to dry in shade.
- ✓ The dried leaves were then ground into powder form.
- ✓ The average weight of powder from each plant is about 21gms.
- ✓ In one hectare, the yield of Sesbania aculeata ranges between 15-25 tons (http://aaqua.persistent.co.in).
- ✓ Hence the total yield per hectare would be about 2100 kg.

Table-I
Total yield per plant of Sesbania aculeata

Growth in cm	Average yield per plant of wet leaves (in gms)	Weight of dry leaves (in gms)	Weight in powder form (in gms)
190-197 cm	163gm	55gm	49gm
125-135 cm	33 gm	13gm	11gm
70-79 cm	10gm	3gm	2gm

Colors Obtained From Dyeing On Cotton

After dyeing the shades achieved on cotton according to pantone shade card were 454CS*, 452CS*, 5807CS*, 4525CS*, 5855CS* (Fig-III). Some shades were towards redder side while others towards blue. Various hues were obtained from these different mordants. When all three mordanting techniques were compared, the pre mordanting technique gave darker shades than others. In all the three methods pomegranate, myrobalan and tea leaves treated samples had darker shades on cotton than other two mordants (gooseberry and sweet lemon).

Colors Obtained From Dyeing Silk

The shades achieved on silk fabric with Sesbania aculeata according to pantone shade card were 5855CS* 5875CS* 468CS* 615CS* 616CS* (Fig: IV).

Silk treated with bio- mordants had even shades in all the three mordanting techniques. The silk fabric treated with tea leaves as mordant had darker shades than others mordanted fabrics in all three mordanting methods. In the study silk had lighter shades than to cotton fabrics.

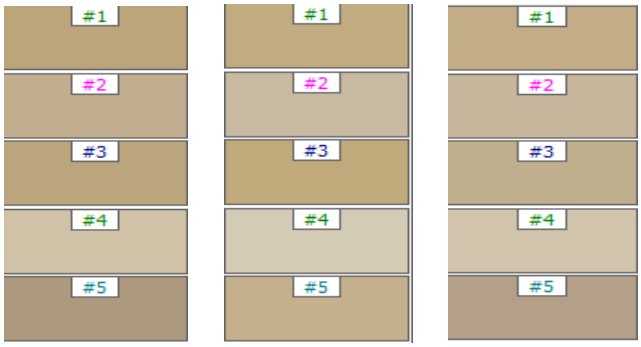
Measurement Of K/S, L A* B* Values*

Besides the variation in shades the K/S and L, a, b values suggesting lightness and shades also showed variation after dyeing (Table II). Significant variations in *K/S* values were noticed in all the fabrics in cotton dyed fabric with tea leave using the mordanting techniques.

International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 10, October 2014)

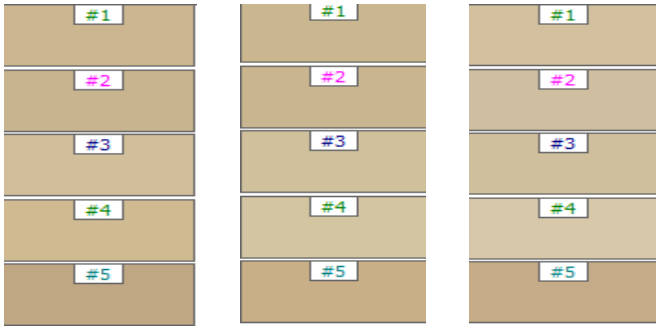
Table II
The K/S and L*, a*, b* for pre mordanted dyed Cotton and Silk Fabric

cotton	K/S	L*	a*	b*
Control	2.642	83.199	0.267	8.946
Pomegranate	15.020	84.888	0.650	15.934
Gooseberry	9.654	82.554	1.311	10.046
Myrobalan	15.055	85.226	0.320	17.119
Sweet lemon	5.018	82.922	0.150	10.531
Tea- leaves	16.104	83.989	0.621	14.100
Silk				
Control	4.940	80.452	1.117	19.052
Pomegranate	8.610	79.911	0.620	19.548
Gooseberry	9.321	79.364	0.652	18.676
Myrobalan	6.707	79.482	0.290	18.717
Sweet lemon	8.011	79.538	0.166	18.819
Tea- leaves	12.253	79.265	2.514	19.175



PRE MORDANTING SIM MORDANTING POST MORDANTING

Figure III: Shades Obtained On Cotton Fabric After Dyeing Using Different Mordants



PRE MORDANTING SIM MORDANTING POST MORDANTING

(1-POMEGRANATE, 2- GOOSEBERRY, 3- MYROBALAN, 4- SWEET LEMON, 5- TEA- LEAVES

Figure IV: Shades Obtained On Silk Fabric After Dyeing Using Different Mordants

International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 10, October 2014)

VI. Colour Fastness Testing

A dye a fabric would be of any use only if colours are fast. colour fastness can be defined as the resistance of a material to change in any of its colour characteristics, to transfer its colourant to adjacent materials, or both, as a result of the exposure of the material to any environment that might be encountered during the processing, testing, storage or use of the material. Fastness testing of the sesbania aculeata dyed samples was carried out according to AATCC (American Association of Textile Chemists and Colourists) standards and methods. The results of the tests conducted are described below.

Colour Fastness To Washing

Wash fastness experiments indicated higher fading of dyed fabrics in cotton (1 grade) in than silk fabric (5 grades). Hence silk has very high wash fastness than cotton when dyed with sesbania aculeata.

Colour Fastness For Daylight/Sunlight

Light fastness properties of cotton fabric treated was moderate in all the three mordanting techniques. The silk fabric treated showed higher light fastness in pre mordanting and post mordanting techniques. Light fastness of silk was higher than cotton.

Colour Fastness To Rubbing

Dry rubbing fastness of dyed cotton fabric treated with myrobalan as mordant had little lower dry fastness in pre mordanting technique than the other dyed cotton fabrics. Wet rubbing fastness of cotton fabric ranged between 2 to 4 which indicated that the fastness was moderate to low.

The cotton fabric treated with sweet lemon as mordant showed higher wet rubbing fastness than the other dyed cotton fabrics in simultaneous mordanting technique. In pre mordanting technique, the silk fabric treated with gooseberry as mordant showed less dry rubbing fastness while other dyed silk fabrics showed better results on all samples. The silk fabric had moderate wet rubbing fastness in all treated silk fabrics.

VII. Conclusions

The study suggests that, Sesbania aculeate is a fast growing economically viable plant which has various medicinal and other uses (Brown, W.H. 1954). It can also be used as a dye for colouring textiles. The plant is grown throughout India and is easily available. Different shades ranging from golden to rusty green color can be obtained with this plant using different natural Bio-mordants with and different mordanting techniques. The dye gave very good results on silk and can also be used on cotton fabrics.

REFERENCES

[1] AATCC Technical manual (2008): American Association of Textile Chemists and Colorists, (AATCC): 83.

[2] Adeel, S., Ali S., Bhatti, I.A. and Zsila, F. (2009): Dyeing of Cotton fabric using Pomegranate (Punica Granatum) Aqueous extract, Asian J.Chem, 21(5): 3493-3499.

[3] Brown, W.H. [1954], "Useful plants of the Philippines", Republic of Philippines Department of Agriculture and Natural Resourc es Technical Bulletin No. 10, Vol: 2.

[4] Swami Charu, Saini Sangita, Gupta V.B., (2012) "A Study on Green Dyeing of Cotton with Ethanolic Extract of Sesbania aculeata", Universal Journal of Environmental Research and Technology, vol: 2, 39-42.

[5] Pantone Colour Maching System.